

PATENT APPLICATION
IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re application of

Docket No: Q85487

Kazuyuki TOHJI, et al.

Appln. No.: 10/518,934

Group Art Unit: 1755

Confirmation No.: 1299

Examiner: Patricia L. HAILEY

Filed: December 22, 2004

For: HIGHLY ACTIVE PHOTOCATALYST AND PROCESS FOR PRODUCING THE
SAME

APPEAL BRIEF UNDER 37 C.F.R. § 41.37

MAIL STOP APPEAL BRIEF - PATENTS

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

In accordance with the provisions of 37 C.F.R. § 41.37, Appellant submits the following:

Table of Contents

I. REAL PARTY IN INTEREST.....	2
II. RELATED APPEALS AND INTERFERENCES	3
III. STATUS OF CLAIMS.....	4
IV. STATUS OF AMENDMENTS.....	5
V. SUMMARY OF THE CLAIMED SUBJECT MATTER	6
VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL	11
VII. ARGUMENT.....	12
CLAIMS APPENDIX	31
EVIDENCE APPENDIX:	35
RELATED PROCEEDINGS APPENDIX.....	36

I. REAL PARTY IN INTEREST

The real party in interest is Nittetsu Mining Co., Ltd.

II. RELATED APPEALS AND INTERFERENCES

Appellants, Appellants' legal representative and the Assignee of this application are not aware of any other appeals or interferences that will directly affect, or be affected by, or have a bearing on the Board's decision in the pending appeal.

III. STATUS OF CLAIMS

Claims 1-23 are pending in the application.

This is an appeal from the Examiner's rejection of claims 1-3, 6-8 and 10-18 under 35 U.S.C. § 103(a) over Hirai et al and from the rejection of claims 1-8, 12 and 19-23 under 35 U.S.C. § 103(a) over Bühler et al.

IV. STATUS OF AMENDMENTS

The Amendment submitted on March 7, 2006 is the last response submitted with amendments to the claims of the application. The Amendment filed on March 7, 2006 was entered. There are no outstanding amendments to the claims or to the specification in the present application.

V. SUMMARY OF THE CLAIMED SUBJECT MATTER

The present invention relates to a photocatalyst. More particularly, this invention relates to a photocatalyst which has high catalytic activity, is nontoxic, has a long life, can utilize visible light as it is for photocatalytic reactions, and is useful especially for hydrogen generation, etc., and to a process for producing the same. Specification, page 1, lines 6-11.

There has been a desire to obtain chemical energy from solar energy, i.e., to utilize hydrogen energy, which is infinite and clean. Energy issues in the 21st century and the global warming effect of carbon dioxide produced by fossil energy as well as environmental pollution including acid rain can be resolved by putting that energy into practical use. Specification, page 1, lines 14-20.

Many investigations have been made for techniques to convert light energy into chemical energy based on the principle that water can be decomposed into oxygen and hydrogen with light energy. However, no improvement in the efficiency of light energy conversion in the visible light region has been made so far. As a result of active investigations made during the time period from 1980 to 1990, it was demonstrated that the electrons and holes generated by optical excitation recombine before reaching reaction sites for water decomposition, and that this recombination governs the conversion efficiency. There was an attempt to utilize an intercalation compound in order to separate reaction sites in view of that conclusion. Although the conversion efficiency has been gradually improved, a satisfactory conversion efficiency in the visible light region has not yet been attained. This is because complete separation of reaction

sites, i.e., separation between electrons and holes, has not been attained. Specification, page 1, line 21 to page 2, line 15.

Investigations were also made on a reaction system for yielding hydrogen by utilizing light absorption by ions in a solution. It has been reported that hydrogen is generated at a high quantum efficiency in an acidic solution containing iodine ions and in an alkali solution containing sulfur ions, respectively. However, all these reactions are possible with high-energy ultraviolet light having a wavelength of 250 nm or shorter. Specification page 2, lines 16-25.

On the other hand, since photocatalysts have the property of accelerating various chemical reactions such as, e.g., the decomposition of environmental pollutants, malodorous ingredients/various bacteria, or the like, they have come to be practically used in applications such as tiles having antibacterial activity and antibacterial/deodorizing filters for air cleaners. Furthermore, it is possible to cause a photocatalyst to act on a harmful substance to obtain a useful chemical substance therefrom. For example, photocatalysts are expected to be applied to a crude oil desulfurization step. Specification, page 3, lines 1-9.

Conventionally, in the step of desulfurizing crude oil, heavy naphtha is subjected to hydrofining during crude oil distillation to recover sulfur ingredients contained in the crude oil as hydrogen sulfide. This hydrogen sulfide is recovered after oxidation of sulfur through a process called the Claus process. The Claus process is a process in which one-third of the hydrogen sulfide is oxidized into sulfurous acid gas and this gas is reacted with the remaining hydrogen sulfide to obtain elemental sulfur. Specification, page 3, lines 10-17.

This process necessitates an enormous amount of energy because of not only the catalytic reaction of sulfurous acid gas with hydrogen sulfide, but also because of repetitions of heating and condensation. It further has problems, for example, in that the management of sulfurous acid gas is costly. Specification, page 3, lines 18-22.

If a method in which an alkaline water containing hydrogen sulfide dissolved therein and to which a photocatalyst is added is irradiated with ultraviolet rays so that the free electrons and holes generated by the photocatalyst absorbing the energy of the ultraviolet light may oxidize and reduce the alkaline water containing hydrogen sulfide to produce hydrogen and sulfur can be put to practical use, or if a method for decomposing hydrogen sulfide with a photocatalyst to yield hydrogen and sulfur, can be put to practical use, it becomes possible to decompose hydrogen sulfide as a harmful substance with a smaller amount of energy to produce hydrogen and sulfur as useful substances. Namely, these techniques contribute to the resolution of environmental problems and enable the useful substances to be produced at low cost. Specification, page 3, line 23 to page 4, line 10.

However, the photocatalysts previously proposed had the following problems which should be overcome. First, the catalytic activity is low. Second, the photocatalysts are toxic. Although the photocatalysts generate free electrons and free holes upon irradiation with light, the probability that the free electrons recombine with the free holes is high. Furthermore, the probability that chemical substances formed through decomposition by oxidation/reduction reactions recombine with each other and return to the original compound is also high. As a result, the catalytic activity is low. Specification, page 4, lines 11-29.

Third, the catalysts have a short life. The prior-art photocatalysts have the following problem concerning photodissolution. Although the photocatalysts generate free electrons and free holes upon irradiation with light, the catalysts themselves are oxidized/reduced in addition to the target chemical substance because of the high susceptibility to oxidation/reduction reactions of these electrons and holes. The catalysts thus dissolve away and are deprived of their catalytic activity. Specification, page 4, lines 130 to page 5, line 1.

For overcoming these problems, JP-A-2001-190964 (of record) discloses a photocatalyst having high catalytic activity, no toxicity, and a long life. Thus, the three problems described above were eliminated. Specification, page 5, lines 2-5.

However, the photocatalyst disclosed in JP-A-2001-190964 is limited to one comprising ZnS. Since the band gap for ZnS is in the ultraviolet region, it has been impossible to utilize visible light such as, e.g., sunlight, which is infinite clean energy, as it is for photocatalytic reactions. Specification, page 5, lines 6-10.

Accordingly, an object of the present invention is to overcome the drawbacks of the related-art techniques described above and to provide a photocatalyst which has high catalytic activity, is nontoxic, has a long life, can utilize visible light as it is for photocatalytic reactions, and is useful especially for hydrogen generation. Specification, page 5, lines 11-16.

Another object of the invention is to provide a process for producing the photocatalyst. Specification, page 5, line 16.

As a result of intensive investigations, the present inventors have succeeded in eliminating those problems by employing the following:

(1) A photocatalyst comprising a capsule structure which comprises a cadmium compound shell and a void and having an average particle diameter of 100 nm or less. Specification, page 5, lines 23-25 and page 9, lines 16-18.

(2) A process for producing a photocatalyst comprising a capsule structure which comprises a cadmium compound shell and a void, said process comprising dropping a solution of a cadmium salt into a solution of a sodium compound. Specification, page 6, lines 19-21 and page 6, lines 16-18.

(3) A process for producing a photocatalyst, which comprises admixing a solution of a sodium compound in a suspension of particles of a cadmium compound. Page 7, lines 8-10.

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL¹

Claims 1-3, 6-8 and 10-18 stand rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Hirai et al. (U. S. Patent 6,051,614).

Claims 1-8, 12 and 19-23 stand rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Bühler et al. (U. S. Patent 4,484,992).

¹ Applicants note that claims 1 and 3-5 are provisionally rejected on the grounds of non-statutory obviousness-type double patenting as allegedly being unpatentable over claim 1 of co-pending application No. 10/507,895. However, this ground of rejection is not being appealed at the present time.

VII. ARGUMENT

- A. **The rejection of claims 1-3, 6-8 and 10-18 under 35 U.S.C. § 103 based on Hirai et al should be reversed because Hirai et al does not teach or suggest all elements of the claims.**

1. **Claims 1, 2, 3 and 6**

The Examiner relies on Hirai et al as disclosing a method for preparing a non-aqueous dispersion of metallic particles and/or metal compound particles, wherein the particles are advantageously used for producing catalytic materials. Specifically, the Examiner relies on the disclosure of Hirai et al at column 2, lines 50-56, which the Examiner considers as reading on the claimed “photocatalyst”.

Claim 1 of the present application recites a photocatalyst comprising a capsule structure, which comprises: (1) a cadmium compound shell; and (2) a void. The photocatalyst also has an average particle diameter of 100 nm or less.

As described in Appellants’ specification, the shell of the photocatalyst of the invention has a stratified structure formed by a particle layer of a cadmium compound. Specification, page 11, lines 1-4 of the paragraph bridging pages 11 and 12. Since the shell of the photocatalyst has a stratified structure, it has innumerable pores defined by interstices existing among the cadmium particles connected to one another. Page 12, lines 10-15.

The photocatalyst of the present invention having a capsule structure comprising a cadmium sulfide compound shell and void is obtained by a characteristic process of reacting a sulfurizing agent on a cadmium oxide (hydroxide) once prepared, instead of an aqueous solution of a metal salt, thereby promoting a process of dissolution of cadmium oxide (hydroxide);

reaction of cadmium ions and sulfide ions in the sulfurizing agent; and shell formation containing cadmium sulfide. See specification, page 16, lines 2-9.

To the contrary, Hirai et al is not related to the present invention and does not disclose a photocatalyst having a capsule structure comprising a cadmium compound shell and a void. Specifically, Appellants previously noted that laid-open JP 5-271718 (hereinafter JP '718, of record) corresponding to Hirai et al discloses mixing a surfactant and a non-aqueous solvent to an aqueous dispersion of metal (compound) particles, and further adding a water-soluble salt of an inorganic acid/organic acid to thereby displace the metal (compound) particles to the non-aqueous solvent phase, thus obtaining a non-aqueous dispersion of the metal (compound) particles. This process is different from the characteristic process for forming the photocatalyst of the present invention having a capsule structure.

Also, Appellants previously pointed out in the Amendment filed March 7, 2006 that the description at column 5, lines 18-24 of Hirai et al (US '614) merely describes that "an aqueous dispersion of fine particles of a metal sulfide such as copper sulfide, cobalt sulfide, nickel sulfide or cadmium sulfide can be obtained by reacting a sulfurizing agent such as sodium thiosulfate, sodium sulfide, ammonium sulfide, hydrogen sulfide or zirconium sulfide with an aqueous solution of a metal salt corresponding to the desired metal species". Thus, Hirai et al (US '614) is not related to the present invention, and does not disclose a photocatalyst having a capsule structure comprising a cadmium compound shell and a void, as claimed.

In the Final Office Action dated May 26, 2006, page 5, lines 14-15, the Examiner admitted that Hirai et al does not disclose that the particles exhibit a "cadmium compound shell

and a void" (as recited in claim 1) or having pores "extending from its surface to its interior" (as recited in claim 6). However, the Examiner took the position that Hirai et al teaches methods for producing particles comparable to those presently claimed, and that one would reasonably expect the particles produced by the process disclosed in Hirai et al to have a shell and a void, absent a showing of convincing evidence to the contrary.

Appellants respectfully submit that the Examiner has not pointed to a specific teaching or suggestion that would lead one of ordinary skill to modify the disclosure of Hirai et al (to arrive at the invention of claim 1) with a reasonable expectation of success. The subject matter of the present invention is a particle having a specific structure, and a method for producing the same. On the other hand, the subject matter of Hirai et al is "a method for preparing a non-aqueous dispersion of particles", which is different from that of the present invention as discussed above. Further, as pointed out above and in the Amendment filed on March 7, 2006, Hirai et al discloses a process which is different from the characteristic process employed for obtaining the photocatalyst of the present invention. Moreover, Hirai et al discloses that a non-aqueous dispersion of the metal (compound) particles is obtained from the process described in Hirai et al, but not a capsule structure as required by the present claims. Thus, one of ordinary skill in the art would not have been motivated to modify Hirai et al with a reasonable expectation of success.

In the Advisory Action dated October 4, 2006, the Examiner took the position that Hirai et al teaches cadmium sulfide particles, which support a noble metal, and a method that is comparable to the claimed photocatalyst and process. Although acknowledging that Hirai et al discloses a "non-aqueous dispersion," the Examiner asserted that the present claims encompass

the prior art since the claims do not recite whether the “solution of cadmium salt” is aqueous or not. The Examiner also asserts that the particles produced by the process of Hirai et al encompass the claimed range of “100 nm or less” (see col. 5, lines 39-41 or Hirai et al). Further, the Examiner considered that Applicants have not sufficiently shown that Hirai et al does not exhibit the claimed “shell and void” configuration, and that criticality of such configuration (as a basis for patentability) has not been shown.

Appellants submit that the Examiner has not provided a reasonable basis for the assertion that the prior art references *inherently* meet the elements of the present claims.

For reasons of record and the reasons set forth herein, the non-aqueous dispersion of metal compound particles of Hirai et al is not a capsular structure as recited in the present claims. Appellants respectfully submit that the issue is not whether the solution of cadmium salt is aqueous or non-aqueous, but whether the reference teaches a capsular structure having a shell containing a cadmium compound and a void or cavity (between the outer and inner surface of the capsular shell). The fact that Hirai et al discloses a non-aqueous dispersion indicates to one of ordinary skill in the art that a capsule structure is not formed and thus Hirai et al does not teach or suggest a capsule structure. Also, the fact that Hirai et al teaches particles having an average particle diameter within the recited range also does not indicate that the particles have a capsular structure. Therefore, these features, recited in the present claims, patentably distinguish the claimed product from Hirai et al.

The Examiner has the initial burden of providing a reasonable technical basis for the assertion that the prior art references meet the requirements of the present claims, explicitly or

inherently. "The examiner must provide a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied prior art." *Ex parte Levy*, 17 USPQ2d 1461, 1464 (Bd. Pat. App. & Inter. 1990). Since the Examiner has not met this burden, Appellants are not required to provide evidence to show that Hirai et al does not exhibit the claimed capsular structure comprising a cadmium compound shell and a void.

Regarding the Examiner's statement as to criticality of the recited structure, Appellants note that the photocatalyst of the present invention having a capsular structure as recited in the present claims allows for the use of visible light, an inexhaustible source and clean source of natural energy for its photocatalytic activity, is nontoxic and has a long life as compared to a photocatalyst composed of simple particles. See e.g., page 9, paragraphs 3-5. Further, the data provided in the specification sufficiently establishes criticality of the capsular structure of the present invention based upon, for example, a comparison of Example 1 to Comparative Example 3.

Thus, for these additional reasons, claim 1 is patentable over Hirai et al. Claims 2, 3 and 6 depend from claim 1 and are patentable over Hirai et al for at least the same reasons.

Accordingly, Applicants submit that Hirai et al does not render the present invention obvious.

2. Claims 8, 10 and 11

Claim 8 recites a process for producing a photocatalyst comprising a capsule structure which comprises a cadmium compound shell and a void, wherein the process comprises dropping a solution of a cadmium salt into a solution of a sodium compound.

According to the Examiner, the method involves obtaining aqueous dispersions of metal particles such as metal sulfides (e.g., sulfides of metals such as cadmium) by a conventional method in which an aqueous solution of a metal salt is treated with, for example, a sulfide-forming agent. As an example, the Examiner asserts that cadmium sulfide can be obtained by treating an aqueous solution of a metal salt with agents such as sodium sulfide. Sodium hydroxide may also be employed depending on the types of metallic agents particles and/or metal compound particles to be obtained. Examples of metal compound particles used in Hirai et al include particles of metal hydroxides and oxides, e.g., those of metals such as cadmium. Exemplary metal salts employed in the invention of Hirai et al include halides and nitrates. See column line 66 to column 5, line 35 of Hirai et al.

Similar to claim 1, claim 8 requires the photocatalyst product to have a capsule structure which comprises (1) a cadmium compound shell and (2) a void. Hirai et al does not disclose, teach or suggest a capsule structure which comprises a cadmium compound shell and a void for the reasons set forth above. For at least this reason claim 8 is not rendered obvious by Hirai et al.

Additionally, Hirai et al does not disclose, teach or suggest “dropping” a solution of a cadmium salt into a solution of a sodium compound as required by claim 8. The specification at page 18, lines 18-22 discloses that a cadmium salt dropped into a solution of a sodium compound

will first form a microscopic solid phase of cadmium hydroxide, etc., and then turn into a cadmium compound instantaneously to form the shells of capsules of the photocatalyst of the present invention. On the other hand, Hirai et al does not teach, suggest or even mention “dropping” a solution of a cadmium salt into a solution of a sodium compound. Also, none of the working examples of Hirai et al employs a solution of a cadmium salt. Thus, for this additional reason, one of ordinary skill in the art would not have been motivated to modify the disclosure of Hirai et al with a reasonable expectation of success.

Accordingly, the present invention as recited in claim 8 is not rendered obvious by the disclosure of Hirai et al. Claims 10, 11 depending from claim 8 are patentable for at least the same reasons.

3. Claims 12 and 18

Claim 12 recites a process for producing a photocatalyst, which comprises admixing a solution of a sodium compound in a suspension of particles of a cadmium compound.

The Examiner relies on the same disclosure of Hirai et al discussed above with respect to claims 8, 10 and 11. Namely the Examiner relies on Hirai et al as teaching a method which involves obtaining aqueous dispersions of metal particles such as metal sulfides (e.g., sulfides of metals such as cadmium) by a conventional method in which an aqueous solution of a metal salt is treated with, for example, a sulfide-forming agent. See column line 66 to column 5, line 35 of Hirai et al.

Appellants submit that the Examiner has not made a *prima facie* showing of obviousness. Hirai et al generally teaches, “an aqueous dispersion of particles of a metal sulfide such as

copper sulfide, cobalt sulfide, nickel sulfide or cadmium sulfide can be obtained by treating an aqueous solution of a metal salt corresponding to the desired metal species with a sulfide-forming agent such as sodium thiosulfate, sodium sulfide, ammonium sulfide, hydrogen sulfide or zirconium sulfide.” However, claim 12 of the present application requires admixing a solution of a sodium compound in a suspension of particles of a cadmium compound. Hirai et al teaches an aqueous solution of a metal salt and not a suspension. Therefore one of ordinary skill in the art would not have been motivated to modify the disclosure of Hirai et al with a reasonable expectation of success.

Even further, the Examiner is saying, in effect, that it is obvious to try treating various aqueous solutions of particles of metal salts such as copper, cobalt, nickel or cadmium with a sulfide-forming agent so as to obtain the optimum aqueous dispersion of particles of a metal sulfide. However, the applicable law is to the contrary. *See, e.g., In re Sigco*, 36 USPQ2d 1380, 1382 (Fed. Cir. 1995) (citing *In re Dow Chem. Co.*, 837 F.2d 469, 473, 5 USPQ2d 1521, 1532 (Fed. Cir. 1988) (rejecting the "obvious to try" standard)); *In re Deuel*, 34 USPQ2d 1210, 1216 (Fed. Cir. 1995) (“ ‘obvious to try’ has long been held not to constitute obviousness”).

Thus, the Examiner has not set forth a *prima facie* showing of obviousness with respect to the subject matter of claim 12 of the present application. Claim 18 depends from claim 12 and is patentable for at least the same reason.

4. Claim 13

Claim 13 depends from claim 12 and requires that the cadmium compound is cadmium hydroxide.

Appellants respectfully submit that Hirai et al does not teach or suggest the invention of claim 13 for the reasons set forth above with respect to claim 12 and additionally because Hirai et al does not teach or suggest a cadmium hydroxide compound. Hirai et al generally mentions that particles of metal borides, metal sulfides, metal hydroxides and metal oxides may be used as examples of the metal compound particles of the aqueous dispersion. Column 4, line 66 to column 5, line 3. However, with respect to the metal hydroxides, Hirai et al specifically teaches that an aqueous dispersion of particles of a metal hydroxide such as iron hydroxide, aluminum hydroxide, indium hydroxide, tin hydroxide and titanium hydroxide can be obtained by subjecting an aqueous solution of a metal salt or a metal alkoxide corresponding to the desired metal species to a hydrolysis treatment. Column 5, lines 24-29. Thus, Hirai et al does not fairly teach or suggest a cadmium hydroxide or admixing a solution of a sodium compound in a suspension of particles of a cadmium hydroxide. Further, the Examiner has not pointed to a specific teaching or suggestion in the reference to serve as motivation for one of ordinary skill in the art to modify the disclosure of Hirai et al with a reasonable expectation of success. For this additional reason claim 13 is not rendered obvious by Hirai et al.

5. Claim 14

Claim 14 depends from claim 12 and requires that the cadmium compound is cadmium oxide.

Appellants respectfully submit that Hirai et al does not teach or suggest the invention of claim 14 for the reasons set forth above with respect to claim 12 and additionally because Hirai et al does not teach or suggest a cadmium oxide compound. Hirai et al generally mentions that

particles of metal borides, metal sulfides, metal hydroxides and metal oxides may be used as examples of the metal compound particles of the aqueous dispersion. Column 4, line 66 to column 5, line 3. However, with respect to the metal oxides, Hirai et al specifically teaches that an aqueous dispersion of particles of a metal oxide such as magnetite, ferrite, tantalum oxide or zirconium oxide can be obtained by adding sodium hydroxide to a solution of a metal salt corresponding to the desired metal species to render the solution alkaline and heat-aging the resultant alkaline solution. Column 5, lines 35. Thus, Hirai et al does not fairly teach or suggest a cadmium oxide or admixing a solution of a sodium compound in a suspension of particles of a cadmium oxide. Further, the Examiner has not pointed to a specific teaching or suggestion in the reference to serve as motivation for one of ordinary skill in the art to modify the disclosure of Hirai et al with a reasonable expectation of success. For this additional reason claim 14 is not rendered obvious by Hirai et al.

6. Claims 15, 16 and 17

Claim 15 depends from claim 12 and requires that the suspension of particles of a cadmium compound is prepared by mixing a solution of cadmium nitrate with a solution containing sodium hydroxide.

Appellants respectfully submit that Hirai et al does not teach or suggest the invention of claim 15 for the reasons set forth above with respect to claim 12 and additionally because Hirai et al does not teach or suggest a solution of cadmium nitrate much less mixing a solution of cadmium nitrate with a solution containing sodium hydroxide. Further, the Examiner has not pointed to a specific teaching or suggestion in the reference to serve as motivation for one of

ordinary skill in the art to modify the disclosure of Hirai et al with a reasonable expectation of success. For this additional reason claim 15 is not rendered obvious by Hirai et al. Claims 16 and 17 depend from claim 15 and are distinguished over Hirai et al for at least the same reasons.

Accordingly, Appellants respectfully submit that the §103 obviousness rejection based on Hirai et al should be reversed.

B. The rejection of claims 1-8, 12 and 19-23 under 35 U.S.C. § 103 based on Bühler et al should be reversed because Bühler et al does not teach or suggest all elements of the claims.

1. Claims 1, 2, 3, 4, 5, 6 and 7

The Examiner relies on Bühler et al as disclosing a catalyst comprising a cadmium sulfide/semiconductor powder, which is at least partially coated with a noble metal, e.g., platinum, preferably having a particle size ranging from 10 to 1000 Å. The Examiner considers the limitations recited in claims 6 and 7 (regarding the presence of pores) to be encompassed by Bühler et al for the reason that claims 1-5 are said to read on Bühler et al.

According to the Examiner, the catalyst of Bühler et al is taught as being useful in a process for the selective production of hydrogen by means of heterogeneous photoredox catalysts by reacting e.g., mixtures of water and alkali metal sulfites or sulfides under the action of light in a suspension of a cadmium sulfide/semiconductor, wherein the reaction employs light sources such as sunlight, or any desired light having a wavelength, depending on the semiconductor, between approximately 200 and 650 nm.

Claim 1 of the present application recites a photocatalyst comprising a capsule structure, which comprises: (1) a cadmium compound shell; and (2) a void. The photocatalyst also has an average particle diameter of 100 nm or less.

As described in Appellants' specification, the shell of the photocatalyst of the invention is of a stratified structure formed by a particle layer of a cadmium compound. Page 11, lines 1-4 of the paragraph bridging pages 11 and 12. Since the shell of the photocatalyst has a stratified structure it has innumerable pores defined by interstices existing among the cadmium particles connected to one another. Page 6, lines 10-15.

The photocatalyst of the present invention having a capsule structure comprising a cadmium sulfide compound shell and void is obtained by a characteristic process of reacting a sulfurizing agent on a cadmium oxide (hydroxide) once prepared, instead of an aqueous solution of a metal salt, thereby promoting a process of dissolution of cadmium oxide (hydroxide)-reaction of cadmium ions and sulfide ions in the sulfurizing agent-shell formation containing cadmium sulfide. See specification, page 16, lines 2-9.

Appellants have previously pointed out that Bühler et al fails to disclose, teach or suggest a capsular structure comprising a cadmium compound shell and a void as recited in claim 1. Specifically, Bühler et al discloses a process for effectively supporting co-catalyst on a semiconductor powder. Bühler et al teaches coated semiconductor powders and does not refer to "a catalyst" and "a process for producing a catalyst" as in the present invention. The coated semiconductor powders of Bühler et al comprise a cadmium sulfide/semiconductor powder, which is at least partially coated with a noble metal, e.g., platinum. The semiconductor powder corresponds to a photocatalyst of the present invention. The present invention is directed to a specific photocatalyst itself and a process for producing the same. Accordingly, the technical concept of Bühler et al is entirely different from that of the present invention.

Additionally, Bühler et al fails to disclose, teach or otherwise suggest a capsular structure comprising a cadmium compound shell and a void as claimed. Moreover, the Examiner has not pointed to any teaching in the art which might indicate that Bühler et al implicitly or inherently teaches a capsule structure comprising a cadmium compound shell and a void as claimed or that would motivate one of ordinary skill to modify the disclosure so as to achieve the claimed capsular structure with a reasonable expectation of success.

In the Advisory Action dated October, 4, 2006, the Examiner's position was that Bühler et al teaches cadmium sulfide particles, which support a noble metal and a method that is comparable to the claimed photocatalyst and process. Further, the Examiner stated that Applicants have not sufficiently shown that Bühler et al does not exhibit the claimed "shell and void" configuration, and that criticality of such configuration (as a basis for patentability) has not been shown.

However, the Examiner has the initial burden of providing a reasonable technical basis for the assertion that the prior art references meet the requirements of the present claims, explicitly or inherently. "The examiner must provide a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied prior art." *Ex parte Levy*, 17 USPQ2d 1461, 1464 (Bd. Pat. App. & Inter. 1990) Since the Examiner has not met this burden, Applicants are not required to provide evidence to show that Bühler et al does not exhibit the claimed capsule structure comprising a cadmium compound shell and a void.

In this regard, Appellants note that the Examiner's position that the disclosed cadmium sulfide (upon which a noble metal is deposited) meets the elements of the present claims, is not a reasonable basis for asserting that Bühler et al discloses the claimed capsular structure comprising a cadmium compound shell and a void. This is because Bühler et al does not teach or suggest the characteristic process for obtaining the capsular structure comprising a cadmium compound shell and void, and because Bühler et al does not disclose, mention or suggest that the cadmium sulfide particles coated with a noble metal have the required capsular structure. In Bühler et al, cadmium sulfide and titanium dioxide, etc., are exemplified as "a semiconductor powder" (see, e.g., column 2, lines 28-30). For, example, in Example 14 of Bühler et al, it is disclosed that Cd element and platinum are supported on CdS. The CdS is simply used as a catalyst (i.e., host) for supporting platinum (and Cd) thereon. Thus, Bühler et al is directed to a totally different technical concept from that of the present invention.

Regarding the Examiner's statement as to criticality of the recited structure, Appellants note that the photocatalyst of the present invention having a capsular structure as recited in the present claims allows for the use of visible light an inexhaustible source and clean source of natural energy for its photocatalytic activity, is nontoxic and has a long life as compared to a photocatalyst composed of simple particles. See e.g., page 9, paragraphs 3-5. Further, the data provided in the specification sufficiently establishes criticality of the capsular structure of the present invention based upon, for example, a comparison of Example 1 to Comparative Example 3.

2. Claim 8

Claim 8 recites a process for producing a photocatalyst comprising a capsule structure which comprises a cadmium compound shell and a void, wherein the process comprises dropping a solution of a cadmium salt into a solution of a sodium compound.

According to the Examiner, Bühler et al discloses a method for preparing the catalyst by photocatalytic deposition of the metals on the semiconductor powders, advantageously with the addition of acid or salts thereof, in an aqueous solution or suspension of a suitable metal compound or a mixture of suitable metal compounds which is considered to meet the elements of claim 8.

As stated above, Bühler et al discloses a process for effectively supporting co-catalyst on a semiconductor powder. Bühler et al teaches coated semiconductor powders and does not refer to “a catalyst” and “a process for producing a catalyst” as in the present invention for the reasons set forth above.

Similar to claim 1, claim 8 requires the photocatalyst product to have a capsule structure which comprises (1) a cadmium compound shell and (2) a void. Bühler et al does not disclose, teach or suggest a capsule structure which comprises a cadmium compound shell and a void for the reasons set forth above. For at least this reason claim 8 is not rendered obvious by Bühler et al.

Additionally, Bühler et al does not disclose, teach or suggest “dropping” a solution of a cadmium salt into a solution of a sodium compound as required by claim 8. The specification at page 18, lines 18-22 discloses that a cadmium salt dropped into a solution of a sodium compound

will first form a microscopic solid phase of cadmium hydroxide, etc., and then turn into a cadmium compound instantaneously to form the shells of capsules of the photocatalyst of the present invention. On the other hand, Bühler et al does not teach, suggest or even mention “dropping” a solution of a cadmium salt into a solution of a sodium compound. Thus, for this additional reason, one of ordinary skill in the art would not have been motivated to modify the disclosure of Bühler et al with a reasonable expectation of success.

Accordingly, the present invention as recited in claim 8 is not rendered obvious by the disclosure of Bühler et al. Claims 10, 11 depending from claim 8 are patentable for at least the same reasons.

3. Claim 12

Claim 12 recites a process for producing a photocatalyst, which comprises admixing a solution of a sodium compound in a suspension of particles of a cadmium compound.

According to the Examiner, Bühler discloses a method for preparing the catalyst by photocatalytic deposition of the metals on the semiconductor powders, advantageously with the addition of acid or salts thereof, in an aqueous solution or suspension of a suitable metal compound or a mixture of suitable metal compounds which is considered to meet the elements of claim.

Claim 12 of the present application requires admixing a solution of a sodium compound in a suspension of particles of a cadmium compound. Bühler et al generally teaches reacting mixtures of water and alkali metal sulfites or sulfides, alkaline earth metal sulfites or sulfides or ammonium sulfites or sulfides under the action of light in a suspension of a cadmium

sulfide/semiconductor, cadmium sulfoselenium or titanium dioxide/semiconductor powder which is at least partially coated with a noble metal. See Column 2, lines 25-32.

As stated above, Bühler et al discloses a process for effectively supporting co-catalyst on a semiconductor powder. Bühler et al teaches coated semiconductor powders and does not refer to "a catalyst" and "a process for producing a catalyst" as in the present invention. Accordingly, the technical concept of Bühler et al is entirely different from that of the present invention.

Appellants respectfully submit that the Examiner is saying, in effect, that it is obvious to try various mixtures of water and alkali metal sulfites or sulfides, alkaline earth metal sulfites or sulfides or ammonium sulfites or sulfides in a suspension of a cadmium sulfide/semiconductor, cadmium sulfoselenium or titanium dioxide/semiconductor powder so as to obtain the optimum aqueous dispersion of particles of a metal sulfide. However, the applicable law is to the contrary. See, e.g., *In re Sigco*, 36 USPQ2d 1380, 1382 (Fed. Cir. 1995) (citing *In re Dow Chem. Co.*, 837 F.2d 469, 473, 5 USPQ2d 1521, 1532 (Fed. Cir. 1988) (rejecting the "obvious to try" standard)); *In re Deuel*, 34 USPQ2d 1210, 1216 (Fed. Cir. 1995) ("obvious to try" has long been held not to constitute obviousness").

Thus, the Examiner has not set forth a *prima facie* showing of obviousness with respect to the subject matter of claim 12 of the present application.

Therefore one of ordinary skill in the art would not have been motivated to modify the disclosure of Bühler et al with a reasonable expectation of success.

4. Claims 19, 20, 21, 22 and 23

Claims 19 and 21 each depends from claim 8 or claim 12. Claim 20 depends from claim 19 and claims 22 and 23 depend from claim 21.

Claim 21 recites that the process of claim 8 or claim 12 for producing the photocatalyst further comprises suspending photocatalyst particles as obtained in a solution containing sodium sulfite and applying light thereto.

Claims 19 and 20 and 21-23 as dependent upon claim 8 are patentable for at least the same reason as claim 8.

Claims 19-20 and 21-23 as dependent upon claim 12 are patentable for at least the same reasons as claim 12.

Accordingly, Applicants respectfully submit that the §103 obviousness rejection based on Bühler et al should be reversed.

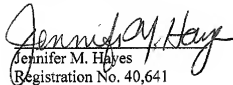
C. Conclusion

In view of the above, Appellants respectfully request the Board to reverse the rejection of claims 1-3, 6-8 and 10-18 under 35 U.S.C. § 103 based on Hirai et al and to reverse the rejection of claims 1-8, 12 and 19-23 under 35 U.S.C. § 103 based on Bühler et al.

The fee required under 37 C.F.R. §41.37(a) and 1.17(c) is being charged to Deposit Account No. 19-4880 via EFS Payment screen.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,


Jennifer M. Hayes
Registration No. 40,641

SUGHRUE MION, PLLC
Telephone: (202) 293-7060
Facsimile: (202) 293-7860

WASHINGTON OFFICE

65565

CUSTOMER NUMBER

Date: April 23, 2007

CLAIMS APPENDIX

CLAIMS 1-23 ON APPEAL:

1. A photocatalyst comprising a capsule structure which comprises a cadmium compound shell and a void and having an average particle diameter of 100 nm or less.
2. The photocatalyst according to claim 1, wherein the average particle diameter is 50 nm or less.
3. The photocatalyst according to claim 1, wherein the cadmium compound is cadmium sulfide.
4. The photocatalyst according to claim 1, characterized by supporting a Group 8 to 11 metal.
5. The photocatalyst according to claim 4, characterized in that the metal is platinum.
6. The photocatalyst according to claim 1, which has a pore extending from its surface to its interior.
7. The photocatalyst according to claim 6, which has a multiplicity of such pores.

8. A process for producing a photocatalyst comprising a capsule structure which comprises a cadmium compound shell and a void, said process comprising dropping a solution of a cadmium salt into a solution of a sodium compound.

9. The process for producing a photocatalyst according to claim 8, wherein the solution of a sodium compound contains sodium sulfite.

10. The process for producing a photocatalyst according to claim 8, wherein the solution of a sodium compound contains sodium sulfide.

11. The process for producing a photocatalyst according to claim 8, wherein the cadmium salt is cadmium nitrate.

12. A process for producing a photocatalyst, which comprises admixing a solution of a sodium compound in a suspension of particles of a cadmium compound.

13. The process for producing a photocatalyst according to claim 12, wherein the cadmium compound is cadmium hydroxide.

14. The process for producing a photocatalyst according to claim 12, wherein the cadmium compound is cadmium oxide.

15. The process for producing a photocatalyst according to claim 12, wherein the suspension of particles of a cadmium compound is prepared by mixing a solution of cadmium nitrate with a solution containing sodium hydroxide.

16. The process for producing a photocatalyst according to claim 15, wherein the solution containing sodium hydroxide contains a chloride.

17. The process for producing a photocatalyst according to claim 16, wherein the chloride is sodium chloride.

18. The process for producing a photocatalyst according to claim 12, wherein the sodium compound is sodium sulfide.

19. The process for producing a photocatalyst according to claim 8 or 12, wherein photocatalyst particles as obtained are caused to support a Group 8 to 11 metal.

20. The process for producing a photocatalyst according to claim 19, wherein the metal is platinum.

21. The process for producing a photocatalyst according to claim 8 or 12, which further comprises suspending photocatalyst particles as obtained in a solution containing sodium sulfite and applying light thereto.

22. The process for producing a photocatalyst according to claim 21, wherein the light is visible light.

23. The process for producing a photocatalyst according to claim 21, wherein the light is solar or pseudo-solar light.

EVIDENCE APPENDIX:

Pursuant to 37 C.F.R. § 41.37(c)(1)(ix), submitted herewith are copies of any evidence submitted pursuant to 37 C.F.R. §§ 1.130, 1.131, or 1.132 or any other evidence entered by the Examiner and relied upon by Appellant in the appeal.

None

RELATED PROCEEDINGS APPENDIX

Submitted herewith are copies of decisions rendered by a court or the Board in any proceeding identified about in Section II pursuant to 37 C.F.R. § 41.37(c)(1)(ii).

None.